PIKE SOLAR LLC

Appendix AK- Road Condition Survey Work Plan

Stantec Consulting Services Inc.
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April 6, 2021
File: 174500433

Attention: David Gardner-Dale, Business Development Associate, Civil Engineer
juwi Inc.
1710 29th Street, Suite 1068
Boulder, Colorado
80301

Dear Mr. Gardner-Dale,

Reference: Road Condition Survey Work Plan

BACKGROUND

juwi Inc. (juwi) plans to develop a large-scale photovoltaic Project (Pike Solar, or, "Project") in El Paso County, Colorado. The Project will be located Southeast of the Landfill and Northeast of Palmer Solar and is planned to have a footprint of approximately 1,200 acres. The construction operations are planned to begin in October 2021 and are expected to last for a duration of 21-24 months. Material deliveries are expected to start approximately two weeks prior to start of the construction activities.

juwi selected Stantec Consulting Services Inc. (Stantec) to develop a Road Condition Work Plan to assess any potential accelerated degradation of the pavements that will be utilized by the construction traffic during the construction period. The goal of this plan is to conduct an objective pavement condition assessment before, during and after the construction operations have been completed to assess the pavement condition and capture Right-of-Way (ROW) imagery to document the condition of the road sections. The pavement condition assessment methodology will be similar to that used by the El Paso County ("The County") to assess their County roads.

Construction traffic is expected to access the Project site through the North and the South Routes listed below in Table 1 and depicted below in Figure 1. Table 1 shows the section limits and estimated centerline lengths.

Table 1: Project North and South Access Paved Road Sections and Centerline Mileage

Route	Street Name	From	To	CL Miles	Route CL Miles
North Route (City of Fountain Truck Route)	CO-16 (Mesa Ridge Pkwy)	I-25 Interchange	Powers Bd S	3.1	9.1
	Mesa Ridge Pkwy*	Power Bd S	Marksheffel Rd S.	1.4	
	Marksheffel Rd S.*	Mesa Ridge Pkwy	Link Rd	0.8	
	C&S Road	Marksheffel Rd S.	Link Rd	0.3	
	Link Rd	Marksheffel Rd S.	Squirrel Creek Rd	1.0	
	Squirrel Creek Rd	Link Rd	2.5 miles E of Link Rd	2.5	
South Route	Old Pueblo Rd*	I-25 Exit	Birdsall Rd	3.0	3.9
	Birdsall Rd*	Old Pueblo Rd	0.9 miles E of Old Pueblo Rd	0.9	

*El Paso County Roads.

Reference: **Road Condition Survey Work Plan**

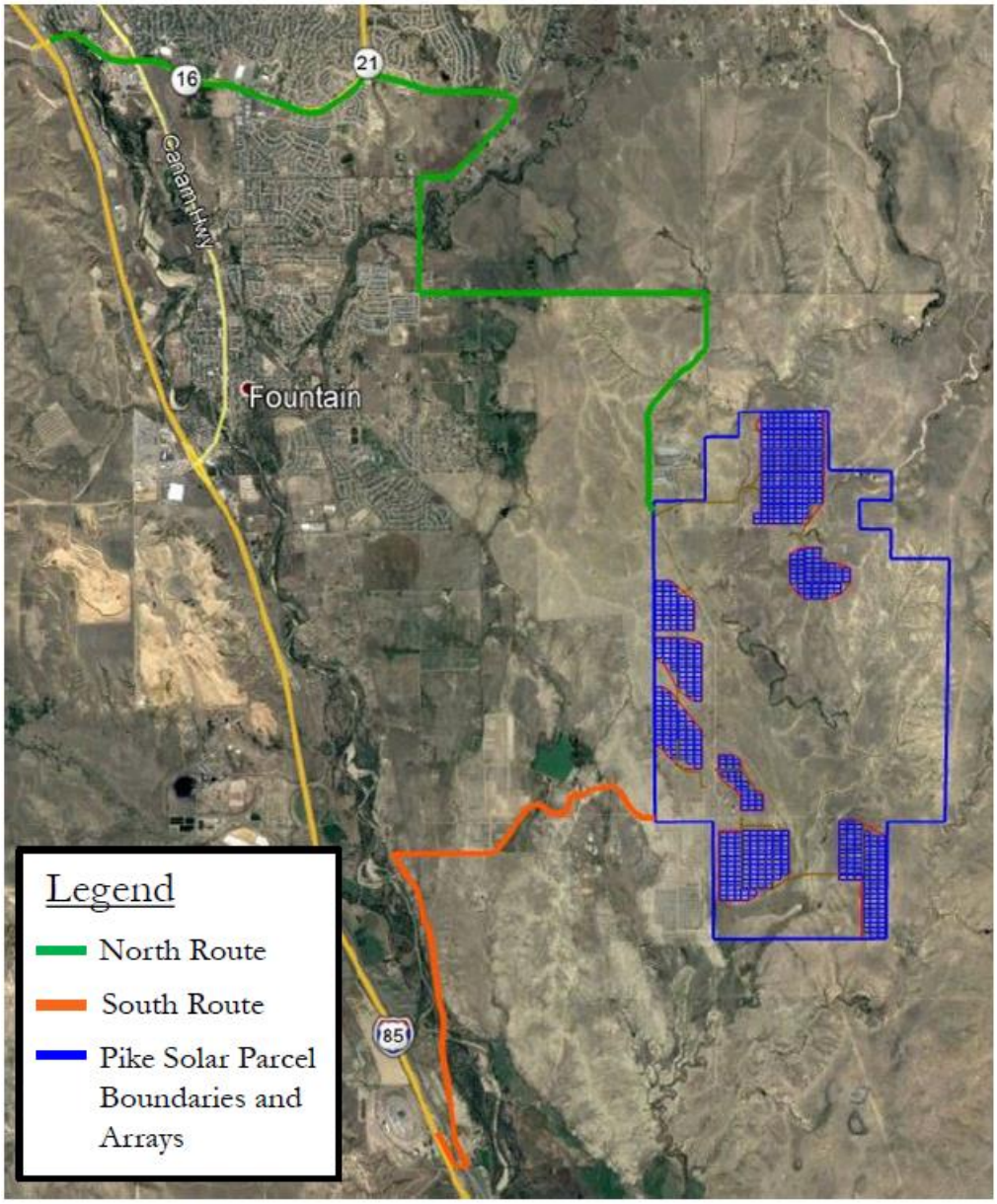


Figure 1: Project North and South Access Routes

CONSTRUCTION TRAVEL ESTIMATES

Construction-related traffic is divided into three categories; 1) Worker Travel; 2) Civil Construction Equipment/Materials; and 3) Solar/Battery System Equipment/Materials. Workers are expected to access the site through the North Route with a total number of daily trips estimated at 50,000 over the 730 days during the construction period. Expected vehicle/truck weights that will access the site range between 2,000 lbs. for light passenger cars up to 66,000 lbs. for various trucks and haulers. Approximately 10 trips are expected to be completed using oversize haulers with a total weight of 110,000 lbs. A haul permit will be obtained for these oversize haulers. Aside from Worker Travel, the vast majority (>95 %) of the trips will use the South Route.

Reference: **Road Condition Survey Work Plan**

TENTATIVE PROJECT SCHEDULE

The tentative project schedule is summarized below in Table 2.

Table 2: Tentative Project Schedule

Activity	From	To
Mobilization of Materials and Equipment	10/04/2021	06/01/2023
Contractor Work	10/18/2021	06/02/2023
Testing, Commissioning, and Close-Out	09/22/2022	09/15/2023

PROPOSED SCOPE OF WORK

The proposed scope of work is summarized below in Table 3. The two major activities that are included in the scope of work are: Pavement Condition Assessment and Pavement Management System (PMS) Analysis. The proposed timing for the field work is also provided below in Table 3.

Table 3: Proposed Scope of Work and Timing

Activity	Round	Start	End
Surface Distress and Roughness Survey on All Lanes of Both North and South Routes. Includes Right-of-Way (ROW) Image capture and processing.	1	During 09/2021	Before Operations begin
	2	During 09/2022	During 09/2022
	3	During 09/2023	During 09-10/2023 after All heavy equipment travel ends

PROPOSED WORK PLAN

Stantec's IMPE team has been actively involved in pavement condition assessment and pavement management system implementations since 1978. With 40+ years of experience in the field, juwi, El Paso County, and the City of Fountain can all be rest assured that a similar strategy has been established and successfully implemented for numerous clients across North America.

Our approach for successfully implementing the proposed scope of work presented above is based on the tasks below.

- Task 1: Data Collection
- Task 2: Data Rating and QA/QC
- Task 3: PMS Implementation and Pavement Condition Analysis
- Task 4: Reporting

Reference: **Road Condition Survey Work Plan**

TASK 1: DATA COLLECTION

Roughness and Rutting

The pavement roughness (longitudinal profile) and rutting (transverse profile) surveys will be completed at the same time as the surface distress survey using the RT3000 vehicle.

The Roughness and Rutting survey will be completed on main lanes of travel on both routes, North and South. Turning lanes will not be tested.

The RT3000 incorporates an ASTM E950 ***certified*** Class I profiler configured to capture longitudinal profile measurements and International Roughness Index (IRI) values in both wheel paths.

The collection of longitudinal profile/roughness data is fully automated. The IRI data is collected continuously and will be summarized at 30-foot intervals. All collected data will be tagged with GPS coordinates and linear referencing measurements.

The specialized profile measurement system, mounted on the front bumper of the RT3000 survey vehicle, employs two sensing devices:

- ***Laser Height Sensors*** that measure the distance between the vehicle and the pavement surface, while the vehicle is traveling at posted speed or less.
- ***Accelerometers*** that measure the vertical acceleration of the vehicle as it bounces in response to the pavement surface profile.

The collected roughness data will be processed and summarized in 100-foot intervals, and an average ***International Roughness Index (IRI)*** will be computed for each roadway section, in the final deliverable table. Areas prohibiting measurement of IRI (i.e., speed < 15 mph) will be documented and provided with an override value, based on testing performed on adjacent sections of the same road. IRI results will be processed within the proposed RoadMatrix PMS to calculate the Ride Comfort Index (RCI). The RT3000 will also measure transverse profile and rut depths, using laser-based, height-measuring sensors. All rut data will be processed at 30-foot intervals. Average rut values, for both wheel paths, will be provided in the final deliverable table, and the values will be used in the rating criteria used for rutting in the surface distress evaluations.

Surface Distresses

The Surface Distress survey will be completed on main lanes of travel on both routes, North and South. Turning lanes will not be tested.

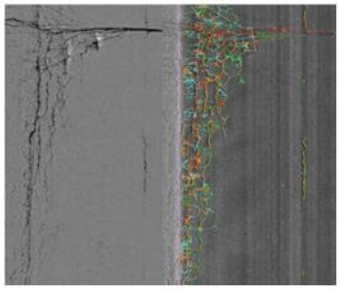
Our Road Tester 3000 (RT3000) simultaneously collects pavement condition, GPS, and digital image data streams. It collects all surface condition data, roughness, rutting, and imagery required. It uses sub-systems for the collection of roughness data, right-of-way (ROW) imagery, GPS, as well as the Laser Crack Measuring System (LCMS).

Reference: **Road Condition Survey Work Plan**

Laser Crack Measuring System (LCMS)

Stantec's LCMS uses laser line projectors, high speed cameras, and advanced optics, to acquire high resolution 3D profiles of the road. This unique 3D vision technology allows for automatic pavement condition assessments of asphalt, porous asphalt, chip seal, and concrete surfaces.

The LCMS acquires both 3D and 2D image data of the road surface with 1mm resolution, over a 13-foot lane width, at posted speeds up to 60 mph. This data collection technique does not impact road users as the vehicle travels at posted speeds.



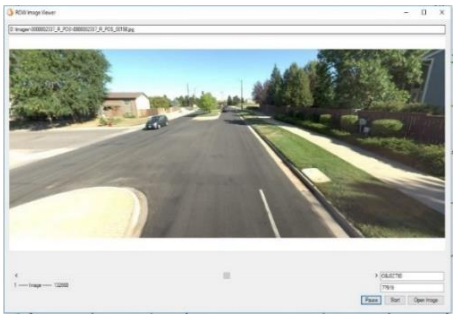
The pavement imagery captured by the RT3000 is subsequently post-processed through Stantec's Imaging Workstation. This system was specifically designed for pavement surface analysis, using both the 3D and 2D pavement imagery components of the LCMS, as well as the collected ROW images. The Imaging Workstation expedites the distress rating process with built-in tools and synchronized images, from multiple cameras. The software is used to detect and analyze cracks, lane markings, ruts, macro-texture, patches, raveling, and potholes. As a result, each distress is **measured**, not estimated, and tagged with a linear reference and corresponding GPS coordinates. The distress data is collected ***continuously*** and summarized at 100-foot intervals.

Some surface deficiencies and distresses (e.g., raveling) are best collected using visual assessment. Our fully trained crew will utilize a specialized keyboard to collect these other distresses when applicable. In the RT3000, Stantec employs a real-time event-recording keyboard to capture any distress/attribute information that cannot be assessed accurately by the linescan approach. Unlike other vendors, who utilize similar digital collection rating systems (DCRS) as a main component of a windshield style survey, our RT3000 technicians do not evaluate and quantify any cracking distresses while driving the streets. Rating cracking by means of a windshield approach, or non-linescan pavement view imagery, has proven to be more subjective, and can yield inconsistent results from year to year. Given our experience using various technologies, we feel the linescan downward imaging objective data process is the best method to ensure consistency and repeatability of the results.

Right of Way Imagery

High-resolution Right-of-Way (ROW) digital images are automatically captured during the pavement distress automated survey and are used internally by Stantec as part of the QA/QC process. The processing of the captured images will provide time-stamped street view imagery that can be viewed within RoadMatrix and within ArcMap as a virtual video. The ROW images will be captured in both directions of travel but only in a single pass per direction.

Stantec's RT3000 collects the digital imagery using a single high resolution ***360° Camera System***. Our 360° Camera System is composed of six 5.0-Megapixel cameras mounted on a singular lever activated support, for the collection of individual or panoramic imagery. The resulting image database contains industry standard JPEGs with geo-referenced information.



The ROW images will support our pavement distress findings and comparisons throughout the project. The ROW images are NOT used to rate the pavement distresses, but rather, to support our pavement condition ratings, which will be completed using the pavement downward images captured using the LCMS system as described above.

TASK 2: DATA RATING AND QA/QC

DISTRESS RATING PROTOCOLS

For this project, pavement distresses will be evaluated using the RoadMatrix rating protocols, which is a modified version of ASTM D6433 Standards. Captured surface distress will be categorized into three levels of severity (Light/Moderate/Severe) and measured units of extent (Length/Area/Count) for each distress type. Table 4 below provides a list of pavement surface distresses that will be collected and rated following the procedures mentioned above. This methodology is similar to what Stantec had used in the past to collect and rate the El Paso County road network in 2017.

Table 4: RoadMatrix Pavement Distresses for Flexible and Rigid Pavements

Flexible Pavements	Rigid Pavements
• Patching • Rippling & Shoving • Raveling & Weathering • Flushing & Bleeding • Distortion (Bumps/Depressions) • Excessive Crown • Progressive Edge Cracking • Alligator Cracking • Potholes • Block/Map Cracking • Longitudinal Cracking • Transverse Cracking • Wheel Track Rutting	• Patching • Scaling • Raveling & Weathering • Polishing • Distortion • C&D Cracking • Coarse Aggregate Loss • Potholes • Joint Sealant Loss • Linear Cracking • Transverse Cracking • Joint Spalling • Joint Faulting/Stepping

Reference: **Road Condition Survey Work Plan**

QUALITY MANAGEMENT

Stantec is proud to hold three ISO certifications: Quality Management (ISO 9001:2008), Environmental Management (ISO 14001:2004), and IT Service Management (ISO 20000-1:2005) that together form our integrated management system. These certifications demonstrate that Stantec meets the accepted standards of care and diligence in how we do business relative to global standards in quality, environmental, IT, risk, and project management. Our system provides clarifications around project delivery and client service excellence.

Stantec employs a strict peer review quality assurance (QA) program that begins at project commencement and continues throughout the life cycle of a project. The QA program is designed to reduce the potential for errors while providing a systematic review of all facets of a project. This formalized project management and review system results in quality project deliverables.

RT3000 Data Workflow / QC Process

Quality Control (QC) is an essential element of any field data collection project, especially when trying to maintain consistency between past and current data collection projects. The quality control of the collection of pavement performance data has always been a driving force for Stantec. We have developed software tools and protocols to assist in monitoring data quality and have extensive experience in implementing and using field and office QC processes.

Field Operations

Our field crews are responsible for the daily operations, in the field. It is important, in a project of this nature, that the technicians use due-diligence and follow a consistent and systematic approach in conducting the condition survey. Since the deliverable will ultimately be produced from the fieldwork, it is imperative that the technicians:

- Adhere to all health and safety guidelines.
- Adhere to the County's and other Owner's traffic regulations.
- Route and track as per pre-defined routing plans – to avoid overlap and duplication.
- Constantly monitor QC systems.
- Make daily data back-ups.
- Communicate with Stantec and juwi/County Project contacts, if questions arise in the field.
- Make decisions as to when surveys should be suspended due to hindrances, such as GPS satellite coverage or weather.
- Report daily, to the Stantec Project Manager, providing a list of roads surveyed that day, and other issues that may have arisen.
- Ensure safety measures are met with respect to both themselves and the public.

Field Quality Control methods are conducted daily and following two key areas: (1) Calibration Checks, and (2) Field and Office Data Verification.

Calibration Checks

Calibration and equipment functionality checks are completed for all on-board systems, each morning before the data collection commences. The RT3000 completes a static calibration twice a day, using on-board software.

This ensures that the equipment is functioning properly and minimizes the possibility of systematic errors associated with the electronics. This same software operates 'behind the scenes' while data is being collected, assuring data integrity. If, at any time, the thresholds are exceeded, data collection is halted until the issues have been resolved.

The GPS system requires that the operator begin collecting data in a static mode, in a GPS-friendly environment (i.e., greater than eight satellites locked), for five minutes before the survey may begin. During this static mode, the operators will run diagnostic tests to confirm that all systems are online and functioning within operational parameters. This approach also provides the post-processing team with initial static tests that increase accuracy of the post-processed GPS data. While in survey mode, onscreen indicators convey messages to inform the operator if there are any thresholds exceeded, at which time, the operator can halt data collection and re-survey the route, if needed.

Customized field QC software is used at the end of each day, to analyze the quality of the pavement and GPS data collected. This software also produces reports, showing real-time accuracy estimates, as well as satellite statistics for the GPS systems. If any results exceed acceptable thresholds, then the route is re-surveyed the following day.

Camera Orientation / Calibration

Calibration checks are performed in the office, prior to field surveys. After the camera calibration is complete, tests are performed using control sites and known monument data to verify the accuracy of the calibration. If the camera orientation changes for any reason during the project, onsite field calibrations are performed, and control sites are selected, to verify the accuracy of the new calibration. Once these QC checks are complete, the field operators resume data collection.

Image Quality

Operators are required to conduct a checklist at the beginning of each day, ensuring that camera settings are correct, and the quality of the images is optimized.

External hard drives containing these images are sent back to the office, each week, where quality checks are performed, and feedback is provided to field staff. If these office inspections reveal any problems, the operators are required to make the appropriate adjustments and retest the sections in question.

Inertial GPS Accuracy

During data collection, an onboard monitoring system is used to show the GPS status and accuracy levels, as well as digital maps of the sections that are being tested. The real-time GPS data points are plotted over the digital map, to provide feedback to the operator that these data points are correct. Throughout the course of the data collection day, it is the responsibility of the systems operator to monitor the real-time.

TASK 3: PMS IMPLEMENTATION AND PAVEMENT CONDITION ANALYSIS

PMS Implementation

The proposed North and South routes were compared against the El Paso County database. The results indicate that not all of the proposed routes are part of the County's database. Figure 2 below depicts the roads that are currently included in the County's RoadMatrix database (depicted in red) versus those that are not a part of the County's database (depicted in Blue).

Reference: **Road Condition Survey Work Plan**

Based on the finding above, Stantec can either add the sections depicted in Blue to the County's database, or Stantec will build a new database to host the routes incorporated in this project. Stantec plans to add a separate section for each road segment and lane combination. Section IDs will reflect the segment name and lane ID.

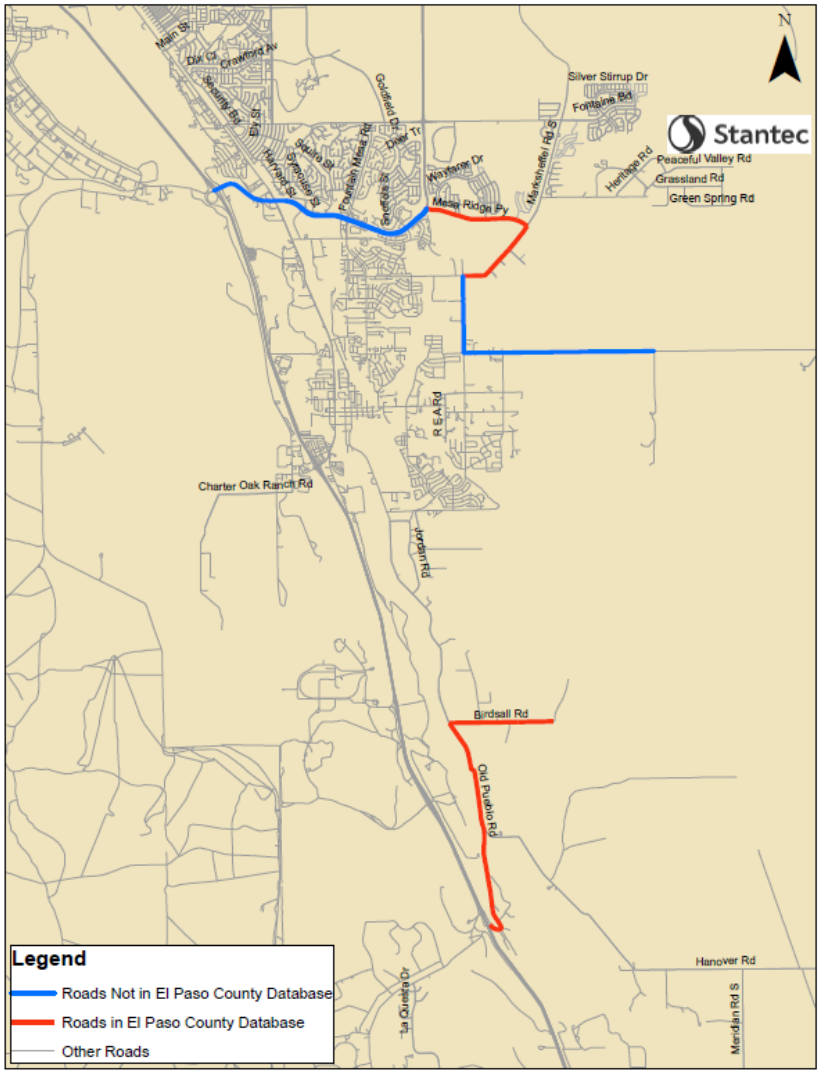


Figure 2: Road Sections Currently Included in El Paso County RoadMatrix Database

Pavement Condition Analysis

After each round of testing, Stantec will upload the detailed condition data (Surface Distresses and Roughness) for each road segment/lane combination to RoadMatrix and run present status analysis to calculate the following performance indices:

- Surface Distress Index (SDI) – Represents the condition of the pavement surface.
- Ride Comfort Index (RCI) – Represents the rideability.
- Pavement Quality Index (PQI) – Represents the overall condition of the pavement section. PQI is a function of SDI and RCI.

TASK 4: REPORTING

Interim Reports

Interim reports will be generated to document the results of the pavement condition surveys. The first interim report will include detailed approach, equipment used, and results of the first condition survey cycles. Follow-up reports will include only the final results of the pavement condition survey after each round of testing.

Final Report

A final report will be submitted that contain the following as a minimum:

- Executive Summary.
- Data Collection procedures and equipment used.
- Results summary of each Surface Distress and Roughness Survey.
- Summary of pavement performance indices (RCI, SDI, PQI) changes over all survey cycles.
- Summary of Conclusions

Reporting Schedule

Table 5: Reporting Schedule

Report	Completion
Interim Report 1 (Approach + Condition Assessment Round 1 Results)	Week of 12/13/2021
Interim Report 2 (Condition Assessment Round 2 Results)	Week of 12/12/2022
Final Report	Week of 1/29/2024

Regards,

Stantec Consulting Services Inc.

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